

**PHYTOTOXICOLOGY INVESTIGATION
REPORT: CANADA BRICK
BURLINGTON (1995)**

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Abstract:

The 1995 investigation around Canada Brick, Burlington, revealed that foliar concentrations of fluoride generally were increased in 1995 from the previous 1993 survey. The most adverse injury to sensitive vegetation (e.g. wild grape), as in previous years, was confined to sites in the immediate area of the company. The increase in vegetation fluoride concentrations in 1995 could have been due, at least in part, to weather conditions. The possibility that fluoride emissions from CB increased in 1995 also can not be ruled out. Canada Brick remains a significant but localized fluoride source.

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Phytotoxicology Investigation Report: Canada Brick, Burlington (1995).

Introduction

In 1995, the MOEE Central Region (Halton-Peel District office) requested a Phytotoxicology assessment of vegetation in the vicinity of Canada Brick (CB), Burlington, to determine the effects of fluoride emissions on surrounding vegetation. Vegetation surveys in the vicinity of this brickwork have been conducted regularly since 1986. A survey was not requested in 1994. CB expanded its brick production facility in late 1986 through mid-1987. This report presents the results of the most recent Phytotoxicology survey conducted on August 30, 1995. The 1986 through 1993 survey results have been previously reported.

CB recently acquired two properties bordering its plant site on the north side of Dundas St. (lumberyard east of railway; residential property east of west entrance). CB now owns all the land north of Dundas St. and east of the CNR tracks through to Bronte Creek, with the exception of the restaurant/gas bar property just west of the east entrance off Dundas Street. The CB property is neighboured to the west by scrub land and commercial-industrial properties, to the north and east by the Bronte Creek valley, and to the south by residential properties and farm fields south of Dundas St. (see attached map).

Investigation Procedures

On August 30 1995, duplicate foliage samples were collected from the same maple tree sites (3, 4, 6, 7, 12, 15, 16, 9, 11) sampled in 1993. The foliage samples were collected from middle branches exposed to the brickwork, using standard procedures. These sites, with the exception of Sites 7 and 16 (west of CB), were situated on or near residential properties (see map). All sites, with the exception of Site 3, were situated off the CB property. During the survey, tree foliage and other vegetation in the vicinity of the collection sites was inspected for fluoride injury.

The foliage samples collected at Sites 3 and 12 were collected jointly by the investigator and CB's consultant (G. Marsden, Agra Consulting). Two large foliage samples were collected from each site and split in half so each party had a matching set of duplicate samples for fluoride analysis. The joint sampling was requested by the consultant so samples could be analyzed immediately to compare with the ambient fluoride concentrations monitored by CB during the growing season.

The foliage samples collected by the Phytotoxicology investigator were returned to the Phytotoxicology laboratory, where they were processed on an "unwashed" basis (oven-dried, ground and stored in glass jars). They were then submitted to the MOEE Laboratory Services Branch for fluoride analysis.

Investigation Findings

Results of Foliar Injury Inspections

Inspections revealed the most severe fluoride injury on wild grape foliage (a sensitive indicator) to the immediate west of CB in the vicinity of Site 7. This site was situated just west of the CNR tracks (east limit of brickwork), and the wild grape plants there had several leaves with light (2-10%) to moderate (11-35%) injury, and moderate injury overall. The wild grape plants at more distant locations in the same weedy field had trace (<2%) or trace to light injury overall through to around Site 16.

Wild grape plants near Site 3 (company property) and near Site 4 to the east of CB had a few leaves with light or moderate injury, but the overall injury severity was closer to trace (<2%) at these locations. Wild grape plants in the vicinity of all other survey sites where grape plants were examined had either no injury or only a few leaves with trace injury. The overall foliar injury on wild grape in the immediate area of CB was not markedly different from previous surveys. The injury to the immediate west in the vicinity of Site 7 was increased slightly from 1993, while the injury near Sites 3 and 4 to the east was decreased slightly in 1995 from 1993.

In addition, a young Eastern white pine close to Site 7 had moderate injury on several current year needles. Also, silver maple Sites 3 and 12 had some leaves with trace injury (blackish tip necrosis) symptomatic of fluoride. Fluoride-like foliar injury also was observed at Manitoba maple Sites 4 and 6. However, Manitoba maples are not reliable indicators of fluoride exposure, as they are susceptible to attack by boxelder borers which can result in foliar injury that mimicks fluoride toxicity. Other vegetation inspected in the survey area did not display fluoride-like injury.

The apple foliage collected at Site 7 was covered with a fine reddish particulate believed to have originated from the neighbouring CB property.

Analytical Results

Table 1 shows the "unwashed foliage" fluoride concentrations encountered from 1986 to 1995 in ug/g (commonly referred to as ppm or parts per million). Similar to previous surveys, foliar concentrations of fluoride were highest at sites close to CB and decreased with increasing distance from CB.

In 1995, the foliage collected at Site 7 (220 ug/g) contained the highest fluoride concentration followed by Site 3 (130 ug/g). These sites have had the highest fluoride levels in most years, especially Site 7. This site is the closest to the brickwork and had what was believed to be brickyard soil particulate on the upper surface on the leaves, which likely contributed to the elevated concentration in 1995. Similar deposition has been observed here in other years.

Compared to 1993, foliar fluoride concentrations were increased at 7 of the 9 sampling sites, including more distant Sites 9 and 11. Fluoride levels at Sites 4, 6, 9 and 11 were the highest since sampling started around CB in 1986. At remaining sites, higher fluoride levels have been detected in previous years. Overall, the mean fluoride concentration of the foliage sites neighbouring CB was increased slightly in 1995 (109 ug/g) from 1993 (96 ug/g). Since 1986, the mean fluoride concentration of the common foliage sites close to CB has ranged from a high of 124 ug/g (1987) to a low of 54 ug/g (1986).

In 1995, all sites, including distant Sites 9 and 11, had a foliar fluoride concentration greater than the Phytotoxicology Section Upper Limit of Normal rural guideline of 15 ug/g (see appendix). Site 9 exceeded the ULN for the first time since 1986. The two highest foliar levels of 220 and 130 ug/g at Sites 7 and 3 closest to CB were 15 and 9 times the rural ULN, respectively. The generally lower levels in the residential area across the road to the south of CB (91 and 105 ug/g at Sites 6 and 12, respectively) were 6 and 7 times the ULN.

Weather Data and Discussion

The wind and rainfall data obtained from the closest weather stations (Oakville, Pearson Airport) for June through August are summarized in Table 2 (wind) and Table 3 (rain). In 1995, the Oakville station revealed a 10% increase in calm winds, resulting in a reduction in winds from most directions, compared to 1992 and 1993. East winds showed about a 2% increase in 1995 from 1992 and 1993. There were fewer days with rain and less rain overall in 1995. June and July received below normal rainfall, while August received above normal rainfall, with most of the rain in August occurring in the first half of the month. There was only a single rain (1.8 mm), and weather conditions were dry, during the two week period prior to the foliage collection at the end of August. Within limits, rain can remove fluoride, especially of the particulate type, by its washing action. This action can be reflected in the analytical results, wherein years with high rainfall should have lower fluoride concentrations if other factors are held constant. Conversely, dry years should be associated with higher fluoride levels. The increase in calm and east winds, together with the overall

reduction in rainfall and dry weather preceding the collection, may have been factors contributing to the general increase in foliar fluoride levels in 1995. The possibility that brick production and fluoride emissions at CB increased during the 1995 growing season also can not be ruled out.

Summary

The 1995 investigation around Canada Brick, Burlington, revealed that foliar concentrations of fluoride generally were increased in 1995 from the previous 1993 survey. The most adverse injury to sensitive vegetation (e.g. wild grape), as in previous years, was confined to sites in the immediate area of the company. The increase in vegetation fluoride concentrations in 1995 could have been due, at least in part, to weather conditions. The possibility that fluoride emissions from CB increased in 1995 also can not be ruled out. Canada Brick remains a significant but localized fluoride source.

Sampling Sites In Area of Canada Brick (CB), Burlington: 1986 to 1995.

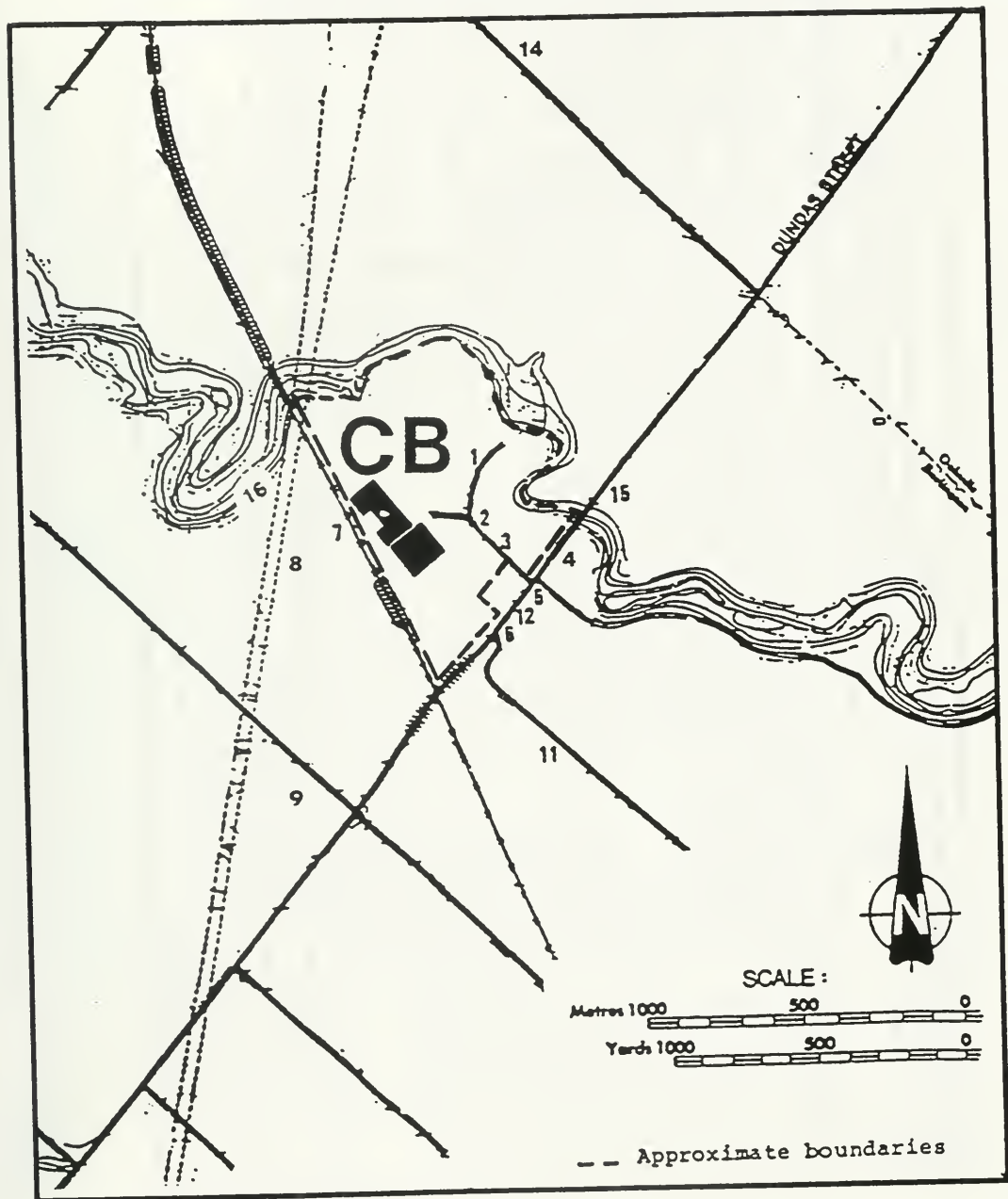


Table 1: Analytical Results: Canada Brick (CB), Burlington (1995)

Site No.	Location**	Foliage Type	Fluoride Concentration* in Unwashed Maple Foliage							
			1986	1987	1989	1990	1991	1992	1993	1995
Sites Neighbouring CB										
3	400 m ESE	Silver maple	70	229	160	248	140	99	155	130
4	550 m ESE	Manitoba maple	33	69	64	66	61	48	59	72
6	540 m SE	Manitoba maple	20	58	68	50	71	50	80	91
7	125 m WSW	Apple	160	269	290	63	285	165	100	220
12	530 m SE	Silver maple	15	89	120	70	86	56	160	105
15	700 m E	Manitoba maple	23	32	26	53	20	20	23	34
16	380 m WNW	Silver maple	NR	NR	NR	20	45	21	12	34
Mean of Common Sites***			54	124	121	92	111	73	96	109
Sites More Distant from CB										
9	960 m SSW	Manitoba maple	8	9	9	7	9	9	9	28
		Silver maple	NR	NR	NR	11	10	NR	9	26
11	960 m SE	Silver maple	12	12	26	13	31	13	22	37
Rural ULN			15							

* ug/g dry weight, mean of duplicate samples and analysis, except in 1990 at Sites 3, 5, 6 and 12 (4 samples/site).

** Approximate distance (meters) and direction from Canada Brick.

*** Common sites excluding Site 16.

ULN - Phytotoxicology Section Upper limit of Normal rural guideline, see appendix. Shaded values exceed ULN.

NR - No result, samples not collected.

Table 2: Wind Data: Oakville Station* (1992, 1993, 1995)			
Wind Direction	Percentage (%) of Time Wind was Blowing from Specified Wind Direction from June through August**		
	1992	1993	1995
<i>North</i>	2.1	2.1	1.8
<i>North northeast</i>	2.1	0.9	1.0
<i>Northeast</i>	1.5	0.8	0.3
<i>East northeast</i>	7.0	3.8	4.6
<i>East</i>	4.8	5.0	6.7
<i>East Southeast</i>	1.5	1.6	1.5
<i>Southeast</i>	4.5	6.6	4.8
<i>South southeast</i>	3.5	2.5	2.2
<i>South</i>	0.8	0.4	<0.1
<i>South southwest</i>	0	0	0
<i>Southwest</i>	0.1	0	0
<i>West southwest</i>	0.5	0.5	<0.1
<i>West</i>	5.9	9.2	4.3
<i>West northwest</i>	8.8	12.5	8.0
<i>Northwest</i>	10.0	8.7	4.8
<i>North northwest</i>	3.7	2.8	1.4
<i>Calm Days</i>	43.2	42.3	53.2
<i>Missing Data</i>	0.1	0.3	5.5
* Bronte Road / Woburn Crescent Station Number 44015			
** From June to foliage collection date: Aug 27 1992; Aug 30 1993; Aug. 30 1995.			
Note: Calm winds are below 5 km per hr.			

Table 3: Rainfall Data: Pearson Airport - June through August (1992, 1993, 1995).												
Amount of Rain (mm)	Number of Days with Rain / Total Rain											
	1992				1993				1995			
	Jun.	Jul.	Aug.*	Tot.	Jun.	Jul.	Aug.*	Tot.	Jun.	Jul.	Aug.*	Tot.
0.2 or more	9	13	13	34	13	10	10	33	6	13	10	29
1.0 or more	8	13	10	31	10	8	7	25	4	10	9	23
2.0 or more	4	10	10	24	8	6	5	19	4	8	6	18
10 or more	1	6	2	9	5	2	1	8	2	2	4	8
Total Rain	37.2	134.5	116.0	287.7	133.8	87.7	38.7	260.2	52.1	55.4	134.2	241.7
Normal	67.1	71.4	76.8	215.3	67.1	71.4	76.8	215.3	67.1	71.4	76.8	215.3

* From June through to and including date of foliage collection: Aug. 27, 1992; Aug. 30, 1993 and 1995.

** Normals for August represent all of August. Normals were taken from Environment Canada 1995 monthly weather summary.

Appendix

Derivation and Significance of the MOEE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

The MOEE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a pollution source. Urban ULN guidelines are based on samples collected from urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (reference: Ontario Ministry of the Environment. 1989. Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxicology Samples. Phytotoxicology Section, Air Resources Branch: Technical Support Sections NE and NW Regions. Report No. ARB-138-88-Phyto. ISBN: 0-7729-5143-8.). Chemical analyses were conducted by the MOEE Laboratory Services Branch.

The ULN is the arithmetic mean plus three standard deviations of the suitable background data for each chemical element and parameter. This represents 99% of the sample population. This means that for every 100 samples that have not been exposed to a pollution source, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOEE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.



